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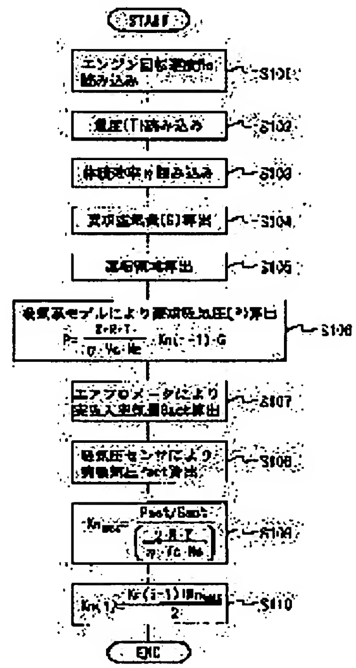
(54) CONTROL DEVICE FOR INTERNAL COMBUSTION ENGINE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a control device for an internal combustion engine capable of converting a demand air quantity G and a demand intake pressure P using an accurate intake system model in the control device for the internal combustion engine that computes demand torque T from the accelerator operating quantity of a driver, a demand air quantity G from the demand torque, the demand intake pressure P from the demand air quantity G, and throttle opening from the demand intake pressure P in regular sequence.

SOLUTION: In this control device, a model error of an intake system model is learned. In the step S106, the relation between the demand intake pressure P and demand air quantity G is computed using the intake system model. In the steps S107, 108, the sensor output values of the actual intake pressure Pact and actual air quantity Gact are read. In the step S109, the model error of the intake system model is computed on the basis of the relation between the actual intake pressure Pact and actual air quantity Gact and the relation between the demand intake pressure P and demand air quantity G.



LEGAL STATUS

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CLAIMS

[Claim(s)]
[Claim 1] The air flow meter which detects the actual air content inhaled by the internal combustion engine, and the intake-pressure sensor which detects the actual intake pressure within inhalation of air, 1st related calculation means to ask for the relation between the intake pressure under predetermined conditions, and an air content using an inhalation-of-air system model, 2nd related calculation means to ask for the relation between the real air content detected by said air flow meter under said predetermined conditions, and the real intake pressure detected by said intake-pressure sensor, The relation of the intake pressure and air content which are computed by said 1st related calculation means, A study amendment means to learn the model error of said inhalation-of-air system model based on the relation of the real intake pressure and real air content which are computed by said 2nd related calculation means, The control unit of the internal combustion engine characterized by having the control means which controls an internal combustion engine based on said inhalation-of-air system model learned by said study amendment means.
[Claim 2] A demand torque calculation means by which said control means computes demand torque based on the accelerator control input of a driver, A demand air content calculation means to compute the demand air content supplied to an internal combustion engine based on the demand torque computed by said demand torque calculation means, A demand intake-pressure calculation means to ask for a demand intake pressure based on the demand air content computed by said demand air content calculation means, and said inhalation-of-air system model learned by said study amendment means, The control unit of the internal combustion engine according to claim 1 characterized by controlling an internal combustion engine's inhalation air content based on the demand intake pressure computed by said demand intake-pressure calculation means.
[Claim 3] Said study amendment means is the learning controller of an internal combustion engine given in either claim 1 characterized by to compute the model error K of said inhalation-of-air system model with the following formulas based on the relation Mod (P, G) of the intake pressure and air content which are computed by said 1st related calculation means, and the relation Act (P, G) of the real intake pressure and real air content which are computed by said 2nd related calculation means, or claim 2.

$$K = \frac{Act(P,G)}{Mod(P,G)}$$

[Claim 4] Said relation Mod (P, G) by the gas constant R, and temperature T, volumetric efficiency eta, cylinder capacity Vc of a combustion chamber and an engine speed Ne It is shown by relation. (2**R**Ts/eta, Vc, Ne) Said relation Act (P, G) The control unit of the internal combustion engine according to claim 3 which is related Pact/Gact of the real intake pressure Pact and the real air content Gact, and is characterized by computing said model error K based on the following formulas.

$$K = \frac{Act(P,G)}{Mod(P,G)} = \frac{P_{act}/G_{act}}{\left(\dfrac{2 \cdot R \cdot T}{\eta \cdot Vc \cdot Ne}\right)}$$

[Claim 5] Said study amendment means is the control unit of the internal combustion engine of any one publication of claim 1 characterized by learning the model error of said inhalation-of-air system model for every operating range thru/or claim 4.
[Claim 6] It has an exhaust-gas reflux means to make an internal combustion engine's exhaust gas re-flow back to a combustion chamber, and a purge means to supply the evaporation fuel which evaporates from a fuel tank all over an internal combustion engine's inhalation-of-air path. Said real air content The air content

detected by said air flow meter, and the air content of the exhaust gas which re-flows back to a combustion chamber with said exhaust-gas reflux means, The control unit of the internal combustion engine of any one publication of claim 1 characterized by being computed based on the air content of the evaporation fuel supplied by said purge means thru/or claim 5.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] The control unit of the internal combustion engine which does study amendment of the relation between inspired air volume (G) and an intake pressure (P) is started.
[0002]
[Description of the Prior Art] The torque which should be conventionally generated with an internal combustion engine is searched for, and the technique of the so-called torque control which controls an internal combustion engine based on this torque is known. In the conventional torque control, as shown in drawing 2 , the accelerator control input of a driver is detected in the accelerator control input detecting element 11, and demand torque (T) is set up based on an accelerator control input in the demand torque calculation section 12. A demand air content (G) is computed from the set-up demand torque (T) on the map in which the relation of the demand air content (G) and demand torque (T) which are beforehand memorized by the engine control unit (ECU is called hereafter) is shown in the demand (air content G) calculation section 13 below.
[0003] Here, the controlled system for attaining a demand air content (G) is the throttle-valve opening (theta) which can be set as adjustable about the effective sectional area in an inhalation-of-air path. In the demand (intake-pressure P) calculation section 14, a demand intake pressure (P) required in order to compute this throttle-valve opening (theta) and to attain a demand air content (G) is computed using the inhalation-of-air system model using a gaseous equation of state. And in the throttle opening (theta) calculation section 15, throttle opening (theta) is computed from a demand intake pressure (P) and a demand air content (G).
[0004] Thus, if a throttle valve is controlled by throttle opening (theta) computed, a demand air content (G) and a demand intake pressure (P) will be realized, and it becomes possible to output demand torque (T).
[0005]
[Problem(s) to be Solved by the Invention] By the way, the inhalation-of-air system model using the equation of state of the gas used in order to compute a demand intake pressure (P) from a demand air content (G) is expressed by (1) equation.

$$P = \frac{2 \cdot R \cdot T}{\eta \cdot V_c \cdot ne} G \quad \cdots (1)$$

[0006] (1) A demand intake pressure (P) is computed by the formula from the volumetric efficiency eta of the inhalation air the demand intake pressure (P) is remembered to be by ECU on the map of an engine speed Ne and a load, and actual temperature T and actual cylinder capacity Vc, engine-speed Ne and a demand air content (G). In addition, R is a gas constant.
[0007] In this (1) type, the median at the time of adaptation is set up and the volumetric efficiency eta of inhalation air has a possibility that volumetric efficiency eta may not be a proper value to each engine, by engine dispersion, engine aging, etc. by ****.
[0008] If volumetric efficiency eta is not a proper value to an engine, in case it will change into a demand intake pressure (P) from a demand air content (G), a conversion error arises and there is a possibility that the actually generated torque may not turn into demand torque (T).
[0009] This invention is made in view of an above-mentioned technical problem, and aims at offering the control unit of the internal combustion engine which can perform conversion to a demand intake pressure (P) from a demand air content (G) with a sufficient precision.
[0010]

[Means for Solving the Problem] According to invention of claim 1, it has the 2nd related calculation means which computes the relation between the 1st related calculation means which computes the relation between inspired air volume and an air content using an inhalation-of-air system model, and the real air content detected by the air flow meter and the real intake pressure detected by the intake-pressure sensor, and the model error of an inhalation-of-air system model is learned based on the relation between an intake pressure and an air content, and the relation between a real intake pressure and a real air content. And a control means controls an internal combustion engine based on the learned inhalation-of-air system model.
[0011] since the model error of an inhalation-of-air system model can be learned to each engine by this by dispersion, aging, etc. of inhalation air according [volumetric efficiency eta] to engine **** even if it is the case where it is not a proper value -- the conversion to a demand intake pressure (P) from a demand air content (G), or the conversion to a demand air content (G) from a demand intake pressure (P) -- precision -- ******** -- things are made. Therefore, an accurate internal combustion engine is controllable.
[0012] In addition, the control means of claim 1 computes demand torque (T) like invention of claim 2 based on the accelerator control input of a driver. The demand air content which was equipped with a means to compute the demand air content (G) supplied to an internal combustion engine based on the computed demand torque, and was computed by the demand air content calculation means (G), It asks for a demand intake pressure (P) based on the inhalation-of-air system model learned by the study amendment means, and an internal combustion engine's inhalation air content is controlled based on the calculated demand inspired air volume (G). Since conversion to a demand intake pressure from a demand air content is performed with a sufficient precision when this controls an inhalation air content, an accurate internal combustion engine is controllable.
[0013] Moreover, the study amendment means of claim 1 computes the model error K of an inhalation-of-air system model with the following formulas based on the relation Act (P, G) of the intake pressure and air content which are computed by the 1st related calculation means, and the relation Mod (P, G) of the real intake pressure and real air content which are computed by the 2nd related calculation means like invention of claim 3.

$$K = \frac{Act(P,G)}{Mod(P,G)}$$

[0014] Thus, from the relation of the actual measurement detected from an air flow meter and an intake-pressure sensor, and the relation of the air content and intake pressure which are computed with the inhalation-of-air system model defined by adaptation etc., since the model error K of an inhalation-of-air system model is computable, this error K can be learned and/or amended to an inhalation-of-air system model. therefore, the thing for which this inhalation-of-air system model learned and/or amended is used -- the conversion to a demand intake pressure (P) from a demand air content (G), or the conversion to a demand air content (G) from a demand intake pressure (P) -- precision -- ******** -- things are made.
[0015] Furthermore, according to invention of claim 4, the model error K of an inhalation-of-air system model is computed with the following formulas based on the relation (a 2**R**T/eta, Vc, Ne) of the intake pressure and air content which are computed by the 1st related calculation means, and the real intake pressure Pact computed by the 2nd related calculation means and related Pact/Gact with the real air content Gact.

$$K = \frac{Act(P,G)}{Mod(P,G)} = \frac{Pact/Gact}{\left(\dfrac{2 \cdot R \cdot T}{\eta \cdot Vc \cdot Ne}\right)}$$

[0016] Thus, from the relation (a 2**R**T/eta, Vc, Ne) between related Pact/Gact of the actual measurement detected from an air flow meter and an intake-pressure sensor, and the air content and intake pressure which are computed with the inhalation-of-air system model defined by adaptation etc., since the model error K of an inhalation-of-air system model is computable, this error K can be learned to an inhalation-of-air system model. therefore, the thing for which the learned inhalation-of-air system model is used -- the conversion to a demand intake pressure (P) from a demand air content (G), or the conversion to a demand air content (G) from a demand intake pressure (P) -- precision -- ******** -- things are made.
[0017] Moreover, a study amendment means learns the model error of an inhalation-of-air system model for every operating range like to invention of claim 5.
[0018] Thereby, the model error of an inhalation-of-air system model can be learned with a sufficient

precision for every operational status.
[0019] Furthermore, said air content is computed like invention of claim 6 based on the air content detected by the air flow meter, the air content of the exhaust gas which re-flows back to a combustion chamber with an exhaust-gas reflux means, and the air content of the evaporation fuel supplied by the purge means.
[0020] Since the mass flow rate of the inhalation air supplied to a combustion chamber in consideration of the effect by purge or the effect by re-reflux of an exhaust gas can be presumed by this, the error of an inhalation-of-air system model can be learned with a sufficient precision, without a purge or being influenced by the exhaust gas of re-reflux.
[0021]
[Embodiment of the Invention] Hereafter, the gestalt of the operation which materialized this invention is explained according to a drawing.
[0022] Drawing 1 is the outline block diagram of the Air Fuel Ratio Control system in the gestalt of this operation. As shown in drawing 1 , the internal combustion engine is constituted as a jump-spark-ignition type engine (henceforth an engine 1) of a 4-cylinder four cycle. The inhalation air passes an air cleaner 2, an inlet pipe 3, a throttle valve 4, a surge tank 5, and an intake manifold 6 from the upstream, and is mixed with the fuel injected from the fuel injection valve 7 for every gas column within the intake manifold 6. And each gas column is supplied as gaseous mixture of a predetermined air-fuel ratio.
[0023] The ignition plug 8 prepared in each gas column of an engine 1 lights the gaseous mixture of each of said gas column to predetermined timing with the high voltage generated with the ignition coil 9. After the exhaust gas discharged from each gas column after combustion passes the three way component catalyst 13 of a purifying-three components of HC, CO, and NOx in exhaust gas sake through an exhaust manifold 11 and an exhaust pipe 12, it is discharged by atmospheric air.
[0024] The air flow meter 21 which detects an inhalation air content is formed in an inlet pipe 3, and the intake-pressure sensor 22 which detects the pressure of inhalation air is formed in the surge tank 5. In addition, the air flow meter 21 is equipped with the inhalation-of-air temperature sensor for detecting the intake-air temperature which is not illustrated.
[0025] Moreover, the throttle sensor 23 for detecting the opening (throttle opening TH) of this valve 4 is formed in a throttle valve 4, and this throttle sensor 23 outputs the analog signal according to the throttle opening TH to it. The throttle sensor 23 contains the idle switch and outputs the detecting signal of the purport whose throttle valve 4 is an abbreviation close by-pass bulb completely. Furthermore, a throttle valve 4 is driven with the throttle actuator 15. As a throttle actuator 15, a well-known DC motor, a torque motor, etc. are used.
[0026] On the other hand, a coolant temperature sensor 24 is formed in the cylinder block of an engine 1, and this coolant temperature sensor 24 detects the temperature (cooling water temperature Thw) of the cooling water which circulates through the inside of an engine 1. The rotational-speed sensor 25 for detecting the rotational speed (engine speed Ne) of an engine 1 is formed in the crank case of an engine 1.
[0027] Furthermore, the limiting current-type A/F sensor 27 is arranged in the upstream of a three way component catalyst 13 in said exhaust pipe 12, in proportion to the oxygen density (or CO concentration in a unburnt gas) of the exhaust gas discharged from an engine 1, it is a wide area and this sensor 27 outputs a linear air-fuel ratio signal. In addition, the A/F sensor 27 is equipped with the heater 47 for attaining activation of the component section (a solid electrolyte and diffused-resistor layer). the cop mold sensor which has the component section formed in the cross-section cop configuration as an A/F sensor 27 -- or the laminating mold sensor by which the laminating of the tabular component section and a tabular heater 47 is carried out, and they change is applicable.
[0028] ECU30 is constituted as a logic operation circuit focusing on CPU, well-known ROM and well-known RAM, Backup RAM (neither is illustrated), etc., computes control signals, such as fuel oil consumption and ignition timing Ig, based on the detecting signal of each of said sensor, and outputs those control signals to a fuel injection valve 7 and an ignition coil 9 further, respectively.
[0029] Moreover, CPU in ECU30 carries out duty control of the amount of heater energization of the A/F sensor 27, and maintains this sensor 27 with an active state. He supplies required electric energy to the heater 47 of the A/F sensor 27, and is trying to hold the chip temperature of the sensor 27 concerned with this operation gestalt in an activity temperature region.
[0030] In the internal combustion engine constituted, thus, ECU30 which controls an engine operation condition By performing torque control PUROGUMU which was constituted considering the microcomputer as a subject and memorized by the ROM (storage) Each function of the demand output-torque operation means 51 shown in drawing 7 , the internal loss-torque operation means 52, the external

load torque operation means 53, the demand illustration torque operation means 54, controlled-variable operation air, a fuel and ignition system each means 56, the air processing subsystem control driving means 57, the fuel system control driving means 58, and an ignition system control driving means It performs. Hereafter, an outline is explained about each [these] function.

[0031] The driver demand output-torque operation means 51 computes the demand output torque based on a map or operation expression from the control input (accelerator opening Acc) of the accelerator pedal detected based on the output of the throttle sensor 23 etc., the real rotational speed Ne of an engine 11, and the target rotational speed Netag. Next, an internal loss-torque operation means calculates an internal combustion engine's internal loss torque based on the output of an engine speed Ne, and the intake pressure Pact detected by the intake-pressure sensor 22 and an internal combustion engine's cooling water temperature Thw detected by the coolant temperature sensor 35. Moreover, an external load torque operation means calculates the load torque which includes the load of supplements, such as a compressor of an air-conditioner, an AC dynamo, and a pump of power steering, etc. based on an air-conditioner signal, a field current of an AC dynamo, etc. which are not illustrated.

[0032] Here, the demand output torque is desired value set up based on the accelerator control input of a driver, and is the desired value of an internal combustion engine's output. Moreover, if external load torque and internal load torque are taken into consideration as mentioned above, the torque which generates the illustration torque generated with the piston driven by the firing pressure by combustion of an engine 11 needs to compensate external load torque and internal load torque, and needs to output the output torque which a driver requires.

[0033] So, with the demand illustration torque operation means 54, the illustration torque generated with a crankshaft 33 is calculated so that it may become the output torque which a driver requires based on the driver demand torque operation means 51, the internal loss-torque operation means 52, and the external load torque operation means 53. That is, it becomes the output torque (net torque) to which the torque which deducted internal load torque and external load torque from the illustration torque generated with a crankshaft 33 is outputted, and a car drive system drives with this output torque.

[0034] Thus, if the demand output torque calculates, according to a combustion gestalt or operational status, the controlled variable of an air processing subsystem, the controlled variable of a fuel system, and the controlled variable of an ignition system will calculate with air, a fuel, and ignition system each controlled-variable operation means 56.

[0035] Here, air, a fuel, and ignition system each controlled-variable operation means 56 are explained. In the torque control of this invention, the accelerator control input Acc by the driver which is not illustrated is inputted into ECU30, calculates the demand output torque from the inputted accelerator control input Acc, and calculates demand illustration torque from this demand output torque, and an internal loss torque and external load torque. Based on this demand illustration torque and engine speed Ne, a demand air content is computed on a map etc. And the demand intake pressure corresponding to demand inspired air volume is computed using an inhalation-of-air system model from the computed demand air content, the command value of throttle opening is computed based on this demand intake pressure, engine-speed Ne and the amount of target EGR(s), the amount of internals EGR (the amount of tooth lead angles of an adjustable valve timing device), etc. by the air processing subsystem control means 57, and the throttle actuator 15 is driven. Here, the model shown by (1) formula which simulated the air mass filled up with the conversion to a demand intake pressure from a demand air content by the combustion chamber using the conservation of mass and a gaseous equation of state is performing the inhalation-of-air system model.

[0036] On the other hand, the fuel system driving means 58 controls a fuel injection valve 7 based on the demand air content and target air-fuel ratio (for example, theoretical **** ratio) which were computed, and injects desired fuel quantity all over an inhalation-of-air path.

[0037] Furthermore, according to operational status, the ignition timing of each gas column is computed on an ignition timing map etc. by the ignition system control means 59, the high voltage is impressed to an ignition plug 8 at the ignition timing, and spark discharge is generated.

[0038] Thus, in the internal combustion engine constituted, the relation between the real intake pressure Pact detected by the intake-pressure sensor 22, and the demand air content (G) and demand intake pressure (P) which are set up based on an inhalation-of-air system model with the real inspired air volume Gact detected by the air flow meter 21 is learned and/or amended with the gestalt of this operation.

[0039] The relation between a demand air content (G) and a demand intake pressure (P) is determined by (1)-type inhalation-of-air system model based on a gaseous equation of state. By the way, in (1) type, volumetric efficiency eta is a constant which is determined by adaptation etc. and is beforehand stored in

ECU. This volumetric efficiency eta is searched for by adaptation etc. using (2) types.

$$\eta = \frac{Gact \cdot R \cdot T}{Pact \cdot Vc} \cdots (2)$$

[0040] (2) In a formula, the real intake pressure with which the intake-air temperature in a manifold and Vc are detected by the volume in a cylinder, and Pact is detected [R] for a gas constant and T by the intake-pressure sensor 21, and Gact are real air contents detected by the air flow meter 21. By using the relation of (2) types, volumetric efficiency eta is computed for every operational status, and is memorized by ECU as a map for every operational status. Drawing 3 is the map of the volumetric efficiency eta acquired as mentioned above. on this map, it has a map for every phase of the variable cam timing device (VCT is called hereafter -- :illustration of is not done) in which the phase of a cam is set as adjustable, and the value of the volumetric efficiency eta according to an engine speed Ne and a load is further stored for every phase of VCT.

[0041] However, volumetric efficiency eta is a constant at the time of adaptation, and has a possibility of becoming that to which the value of volumetric efficiency eta is not suitable for an engine property with engine aging, sensor tolerance, etc., and an error will be included in the conversion to a demand intake pressure (P) from a demand air content (G) as the value of volumetric efficiency eta is an unsuitable value.

[0042] So, with the gestalt of this operation, the program shown in drawing 4 performs accurate study and/or amendment of volumetric efficiency eta. The flow chart of drawing 4 is used for below, and the study approach of the gestalt this operation or the /amendment approach is explained. First, at step S101 and step S102, an engine speed Ne and an intake-air temperature are read, and it progresses to step S103. At step S103, the volumetric efficiency eta according to an engine speed Ne, a load, and the phase of VCT is read from the map of the volumetric efficiency eta of drawing 3 , and it progresses to step S103. At step S103, a demand air content (G) is read from the demand torque (T) which can be found from the accelerator control input of a driver on the map beforehand memorized by ECU30.

[0043] And at step S105, from the demand air content G over an engine speed Ne and an engine speed Ne (G/Ne), a operating range in the study value map of drawing 5 is computed, and it progresses to step S106. At step S106, the last study value Kn (i-1) is called from the operating range of computed drawing 5 , and a demand intake pressure (P) is computed using (3)-type inhalation-of-air system model from the demand air content (G) and the study value Kn (i-1) which were read at step S104.

$$P = \frac{2 \cdot R \cdot T}{\eta \cdot V_c \cdot Ne} \cdot Kn(i-1) \cdot G \cdots (3)$$

[0044] Thus, if demand inspired air volume (P) is computed using (3)-type inhalation-of-air system model, in step S107 and step S108, an air flow meter 21 and an intake-pressure sensor will detect the real air content Gact and the real intake pressure Pact, and it will progress to step S109. The base value KnBASE of a study value is computed at step S109, using (4) types as an error by the inhalation-of-air system model.

$$Kn_{BASE} = \frac{Act(P,G)}{Mod(P,G)} = \frac{Pact/Gact}{\left(\frac{2 \cdot R \cdot T}{\eta \cdot Vc \cdot Ne}\right)} \cdots (4)$$

[0045] (4) In a formula, (2**R**Ts/eta, Vc, and Ne) are the demand intake pressure (P) computed with an inhalation-of-air system model, and relation [the demand (intake pressure P) / demand air content (G)] with a demand air content (G). In this formula, the actual measurement detected from an air flow meter 21 and the intake-pressure sensor 22 and the error included in volumetric efficiency eta from a model value with an inhalation-of-air system model can be given as a base value KnBASE of a study value. and -- a step -- S -- 110 -- a step -- S -- 109 -- computing -- having had -- study -- a value -- the base -- a value -- KnBASE -- last time -- study -- a value -- Kn (i-1) -- from -- (-- five --) -- a formula -- being shown -- as -- 1/2 -- annealing -- processing -- carrying out -- this study value Kn (i) -- computing -- this routine -- ending .

$$Kn(i) = \frac{Kn(i) - Kn_{BASE}}{2} \cdots (5)$$

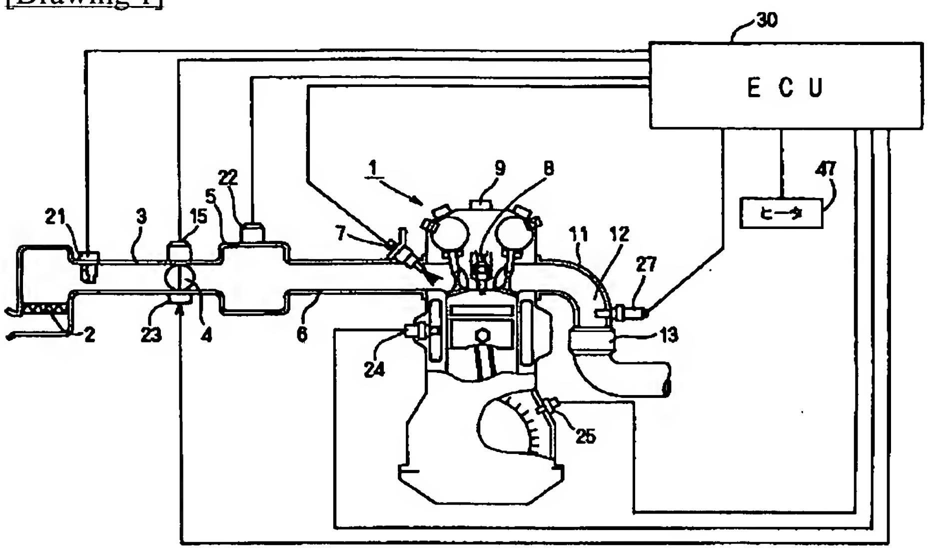
[0046] As mentioned above, with the gestalt of this operation, the relation between a demand air content (G) and a demand intake pressure (P) is computed based on an inhalation-of-air system model, and the error of an inhalation-of-air system model is computed as an error Kn (i) by comparing with the real air content Gact and relation (Gact/Pact) with the real intake pressure Pact. And since this error Kn (i) is stored in ROM in

ECU30 for every operating range, study and/or amendment of an accurate inhalation-of-air system model can be performed to all operating range.
[0047] Thus, since an accurate inhalation-of-air system model can be learned and/or amended, conversion with a demand air content (G) and a demand intake pressure (P) is performed with a sufficient precision, and can control an internal combustion engine's inhalation air content, fuel oil consumption, ignition timing, etc. with a sufficient precision.
[0048] In the gestalt of this operation the 1st related calculation means to step S106 of drawing 4 In the relation (Pact/Gact) of the real air content Gact and the real intake pressure Pact which are read at step S107 and step S108 of drawing 4 , the 2nd related calculation means To step S109 and step S110 of drawing 4 , a study amendment means a control means in the accelerator control input detecting element 11 of drawing 2 , the demand torque calculation section 12, the demand air content calculation section 13, the demand intake-pressure calculation section 14, and the demand throttle opening calculation section 15 A demand air content calculation means is made into the demand air content calculation section 13 of drawing 2 , and a demand torque calculation means makes considerable [of the demand intake-pressure calculation means] to the demand intake-pressure calculation section 14 of drawing 2 , respectively, and functions on the demand torque calculation section 12 of drawing 2 .
[0049] (Other examples 1) In the gestalt of the 1st operation, the study value Kn was stored as a RAM value in ECU30 for every operating range at step S105. However, the study value Kn must be updated for every operating range, and there is a possibility that the study value Kn may not be updated depending on a operating range with low operating frequency. So, it aims at enabling renewal of mitigating data volume and the prompt study value Kn in this example.
[0050] Drawing 6 is drawing having shown the real intake pressure Pact and relation with the real air content Gact for every engine-speed Ne. According to this drawing, the real intake pressure Pact and the relation with the real air content Gact have proportionality (linear function) in the predetermined engine speed Ne. If change of volumetric efficiency eta arises at this time, the effect of change of volumetric efficiency eta will appear in change of the inclination of a linear function. Then, what is necessary is to compute the study value K of predetermined operational status, and just to let the study value K acquired be the study value K in all operating range.
[0051] By doing in this way, by the study value K being updated once, the study to all operating range will be updated and mitigation of data volume and the prompt study value K can be updated.
[0052] (Other examples 2) In this example, the outline block diagram of the gestalt of the above-mentioned operation is equipped with the configuration which supplies the evaporation fuel in a fuel tank to an intake manifold 6, and the configuration which supplies an exhaust gas to an intake manifold 6 as an exhaust-gas re-reflux means (not shown) as a purge supply means (not shown).
[0053] Thus, when it has a purge supply means and an exhaust-gas re-reflux means, the air component of evaporative gas and an exhaust gas affects the mass flow rate of the inhalation air supplied to a combustion chamber. That is, there is a possibility that it may become impossible to compute the volumetric efficiency eta of an accurate combustion chamber, under a purge or the effect of an exhaust gas. So, by presuming the inhalation air content of a combustion chamber in consideration of the air content which contributes the mass flow rate of the inhalation air supplied to a combustion chamber to the output value of an air flow meter 21, and combustion of a purge, and the air content which does not contribute to combustion by re-reflux of an exhaust gas, even if it has a purge and the influence of an exhaust gas, the model error of an inhalation-of-air system model is detectable in this example, with a sufficient precision.

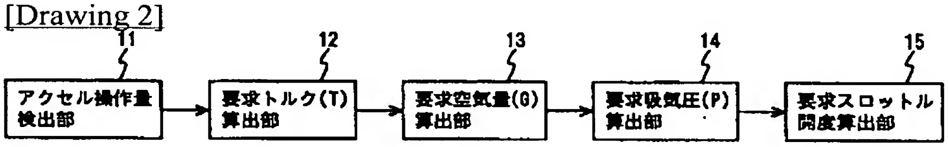
[Translation done.]

DRAWINGS

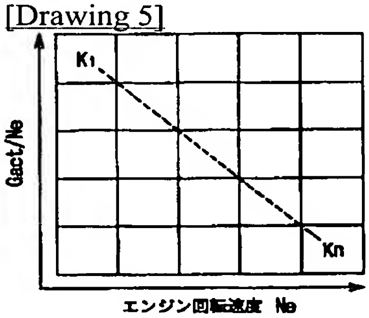
[Drawing 1]



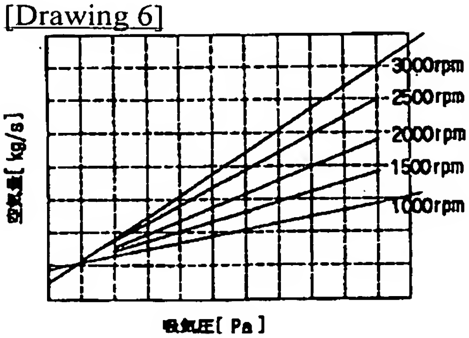
[Drawing 2]



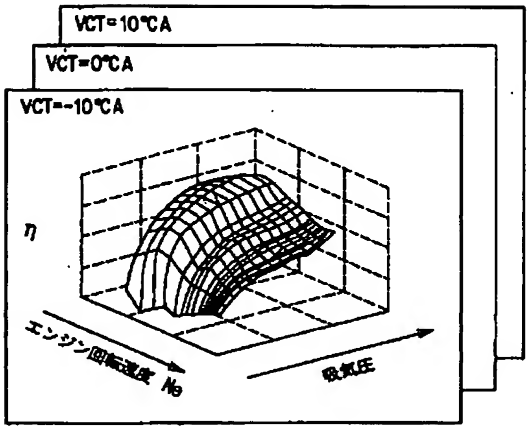
[Drawing 5]



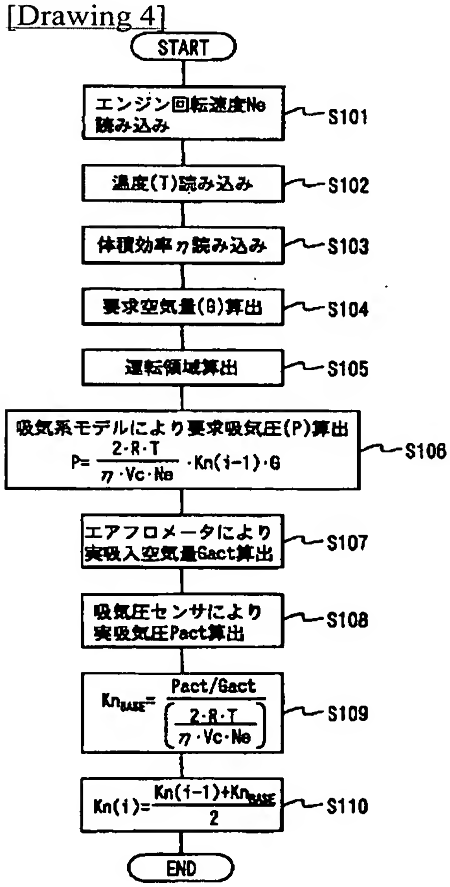
[Drawing 6]



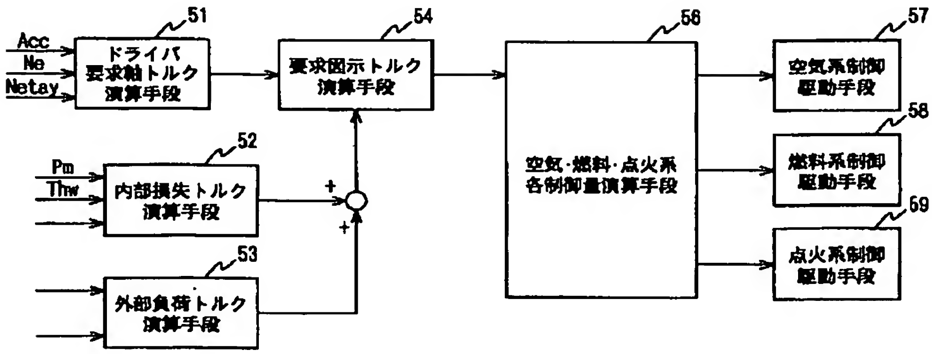
[Drawing 3]



[Drawing 4]



[Drawing 7]



[Translation done.]